

The Lenovo X-60 Convertible Notebook Tablet PC: An assistive technology tool review.

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The purpose of this paper is to examine the suitability of the newest generation of Lenovo X60 tablet personal computers (PCs) as assistive technology (AT) devices for students with disabilities. Because of the vast selection of tablet PCs and convertible notebooks currently available on the market, this paper will confine itself to assessing one convertible notebook tablet PC in particular: the Lenovo ThinkPad X60-636346U Tablet PC with multi-touch screen running Microsoft One Note technology.

Lenovo X-60-636346U Features

The X60-636346U is advertised as the second generation of convertible ultralight and highly portable tablet/notebook hybrids released by Lenovo (Baxter, 2006), a Chinese company which acquired the personal computing division of IBM in 2005 (Lenovo.com, 2007a). It features a 12.1 inch diagonal screen, and is configured with a 1.83 GHz Core Duo Intel low-wattage processor for power, which supplies processing speed up to thirty percent faster than most models, and provides increased energy efficiency. Technically speaking, this tablet PC offers a choice of hard drives from 40 GBs to 120GBs, although the one under review comes standard with an 80 GB hard drive, and features a respectable one Gig of Random Access Memory (RAM) to start, with upgrades available to four Gigabytes of RAM for increased speed. In addition, the X60-636346U offers no less than seven USB ports when purchased with its docking bay option, which also allows the user to add peripheral devices such as printers, scanners and optical drives. This option effectively turns the X60-636346U convertible tablet notebook into a desktop PC.

The X60-636346U model is internet-ready, and comes equipped with access to all known, internationally recognized, internet-ready

connectivity sources currently available including Bluetooth for use with peripheral devices, and WWAN EVDO which allows for internet access in even the most remote locations through cell phone transmission towers and satellites (Baxter, 2006; Lenovo, 2007b).

The Lenovo X60-636346U weighs 1.94 kilograms and is 1.30 inches thick at its widest part, thus making it the lightest and slimmest of the full-sized, full-featured tablets on the market currently (Baxter, 2006; Lenovo, 2007b). This configuration of the X60 tablet PC is equipped with an eight cell battery which offers the user an impressive seven and a half hours of use before needing recharging. An add-on battery for the optional docking bay for this tablet PC would give the user an additional three-and-a-half hours of use, for a total of eleven hours of battery-powered usability, an impressive performance for any computer (Baxter, 2006; Lenovo 2007b).

All X60 models feature a function called "Active Rotate," controlled by an internal gyrometer, which means that no matter which way the user holds the tablet PC, the image that the user sees on the screen is always facing up, permitting viewing and reading from any angle (Baxter, 2006, p. 13; Lenovo, 2007b). This feature can be enabled, locked, or disabled with a simple one button click. The model X60-636346U under review in this paper also features a "MultiView" display monitor which allows the consumer to use the device in all light conditions, including shade and bright sunlight, with no loss of clarity (Baxter, 2006).

The X60-636346U model also features "MultiTouch" screen technology which allows the user to use both a pen-sized stylus for writing and drawing on the tablet screen, to finger-select icons, draw on the screen as desired or needed using a fingertip, or to move the cursor without the use of the stylus (Baxter, 2006). The stylus is the size of a full-sized pen, has a soft rubber grip for comfortable handling, and features a button on the side which enables all right-click features on the screen of the tablet. The trackpoint nib of the stylus is soft and provides the user with the sensation and feel of writing on paper. All models come with replaceable stylus nibs and with optional tethers to prevent inadvertent loss of the

stylus, which is normally housed in a slot in the base of the tablet when not in use (Baxter, 2006; Lenovo, 2007b).

All X60 models are constructed of a magnesium and plastic combination which is reported to be able to withstand a fall from a height of approximately three feet, which is roughly table or lap height (Baxter, 2006). Another key feature of this tablet PC is a spill-proof keyboard, and two drains which channel any spilled fluid away from the device. It also boasts a fingerprint recognition device and several layers of password protection for added security. The pivot hinge which transforms the notebook into a tablet PC is made of a magnesium alloy, which adds stability and strength to a possible weak point and permits viewing and rotation of the monitor screen up to 180 degrees (Baxter, 2006; Lenovo, 2007b). This author found that the pivot hinge was weighty, secure, and pivoted smoothly and flawlessly with minimum effort.

Another outstanding feature of this model is the “Active Protection System” which lifts the read and write head of the tablet PC when sudden or unexpected motion is detected. This protects both the device and the user’s data from loss or damage (Baxter, 2006).

A final set of features which impressed this author are the array of single-push function buttons which Lenovo engineers have thoughtfully left accessible to the user when the PC is in tablet mode. In contrast to other tablet PCs, which commonly cover all vital access controls when in tablet mode, the Lenovo X60-636346U allows single-button access to important features such as task manager, volume controls, and a remarkable one-button system-recovery feature which allows users to reboot their system in the event of a crash or system failure, or to reconfigure the system to an earlier restore point with the push of a single button (Baxter, 2006; Lenovo, 2007b).

How would the model X60-636346U stand up as an assistive device for people with disabilities? The author put this model through its paces and was pleasantly surprised.

Lenovo X-60-636346U as Assistive Technology Device

As King (1999), Goodman, Tiene, and Luft (2002), Andrich and Besio (2002) and others have pointed out, AT has a high rate of failure and abandonment if it is not professionally matched with a client in a culturally sensitive, user-centered, gender and age specific, or skill-based fashion. The primary obstacle to the use of this or any other tablet PC or computer is that the user needs to be computer literate to at least a functionally basic level. Therefore, the user needs to know how to connect to the internet, find, open, save and manipulate files and documents, install and start software programs, and navigate through screens and programs. Since the X60-636346U comes pre-installed with Windows XP-Professional Tablet Edition as an operating system, with a coupon to upgrade to an equivalent, more user-friendly and intuitive version of the new Microsoft Windows Vista system at the user's convenience, most of these functions are not difficult to do with a basic level of computing knowledge and some practice. Still, the fact remains that this device is not one that ordinarily would be picked for a very young or novice computer user.¹ The author is thus writing this review with the understanding that this tablet PC would most commonly be offered to a student with a good grasp of essential computing knowledge and at least a basic level of proficiency.

The Lenovo X60-636346U allows students with a wide array of disabilities to expand the possibility of what they can do while eliminating the need for a lot of extraneous devices. With most tablet PCs, and this one in particular, students can record a lecture during class time; video-tape and record a self-presented lecture as the instructor is presenting it; and download, view, or listen to a pre-recorded lecture from their teacher as homework. For students with vision impairments the ability to record a lecture directly from their computer, without the

¹ At an inner city school in Leicester England, headteacher Kathryn Broadhurst used Toshiba tablet PCs for her class of five and six-year olds to create their art. The Olfsted report for 2003 for their school, the Green Lane Infant School, indicates that the youngsters learned to manipulate the devices quickly, easily, and innovatively with little prompting from their instructors (UK.computers.Toshiba-europe.com, 2007).

need for an additional MP3 player or tape-recording device, is handy indeed and reduces the number of devices the student needs to carry around. The ability to video-tape lectures or presentations with the addition of a low-cost, optional minicam, while handy for anyone, could potentially benefit deaf students who may have missed what was happening in a lecture while focused on their interpreter. For those with ADD or ADHD, the ability to record audio and video will allow repeated playback so that specific parts of lectures or presentations may be reviewed as memory aids. In addition to this, the very interactivity of the ability to record and tape directly from the X60 tablet may prove helpful to those with attention deficit disorders, since these activities not only allow them to focus on doing something specific, but allow the students to feel as if they are part of an interactive process of learning and not just passive observers.

Another feature of this tablet PC which will benefit many students is the ability to use the built-in text-to-speech function to read e-text books and other text materials, and to review notes or readings aloud without the need for additional software. This may also come in handy when students need to hear their paper read back to them for editing purposes. For students with speech difficulties, the Lenovo X60-636346U tablet could act as a surrogate voice for the student in presentations and class discussions. Students would merely need to type in the text of what they wanted to say, and select the gender appropriate computerized voice of their choice to speak in their place.

The speech-to-text feature allows students to dictate their own notes, or to turn a recorded lecture into notes without the need to purchase or install additional expensive software such as Dragon Speaks Naturally. Again, a wide variety of students can benefit from this feature aside from those with disabilities. Those with significant difficulties with writing or composition, those who experience difficulties taking notes, or those who are physically unable to write can all benefit from this feature. In addition to this, the ability to turn recorded lectures into text notes may serve to point out things which students with auditory processing disorders may have missed while listening to a lecture in class.

The addition of Microsoft One-Note to the Lenovo X60-636346U system allows students to download templates which easily turn notes into double-sided flash cards for easy studying, calendars, lists of all kinds, planners, diagrams, organizational charts, schedules and more. One-Note opens up as a series of tabbed notebooks, the equivalent of a tabbed three-ring binder, with tabs for each subject, which present the appearance of lined paper to the user who can write notes onto the tablet PC with the provided stylus pen. In addition to this, users can capture images and text from scanned textbooks, e-texts, instructor-provided overheads, or the internet, and add them to their day's notes with the click of their stylus. This captures both the image and the URL back to the original source of the text or image. Students can also imbed sound and streaming video recordings into their notes to provide a seamless record of what transpired in a particular class for later review. The X-60-636346U can essentially take the place of a tutor for students with cognitive or attention deficit disabilities, since students can effectively capture all sources and links to a piece of knowledge directly into their notes for any given subject, right at the time that they are learning about it. Thus, students are able to revisit images, streaming video, audio sources, notes, and the URL or other source from which they obtained this information at any time, since these links are instantly embedded in their notes as they are accessed and used. So, students no longer need to search for a piece of information in frustration, since the search feature in One-Note will search through the entire computer and all its files for any link to the key words specified no matter which program or feature accessed that piece of information. This also allows students to cross-index information between their notebooks in One-Note and any other program on their tablet PC for instant retrieval as needed, at the touch of a stylus or fingertip. For those with physical issues, this means less clicking, scrolling and other wasted motion, and for those with attention disorders it eliminates much of the frustration associated with forgetting where pieces of information are stored.

This author was particularly impressed with how easy it was to perform these actions and, in a test lecture situation, found the opportunity to review key segments of the lecture at my leisure very compelling. Not only was the lecture preserved, but the X60-636346U captured the notes,

maps and visuals the professor drew on the blackboard flawlessly, thus providing a real-time record of a particular class for reviewing and sharing with absent class members. A built-in annotation feature allowed the author to add notations to any text as well as to PowerPoint slides, thereby increasing functionality and allowing the author to pay more attention to what was happening in the lecture theatre. As mentioned previously, these features could well act in lieu of a tutor, allowing students to pause, replay, or fast forward to the material that they need any number of times, merely by touching their stylus or their fingertip to the tablet screen.

Students can share what they have learned by e-mailing their enriched notes to other students, even those who do not have One-Note technology, through the use of a special file-sharing built-in which decodes the information for other users. This also allows the work to be e-mailed directly to an instructor's computer or laptop for marking or assessment. The ability to share this media-enriched information with others might well increase the interactivity and class participation of students with disabilities who might previously have felt limited by their specific disability from fully engaging with class materials and fellow classmates.

An instructor with a tablet PC, such as this one, can monitor the real-time activities of a class full of users, as well as monitor the specific needs of a student with disabilities. And, by utilizing software programs such as DyKnow Vision², or freeware such as Classroom Presenter³ or Netsupport School⁴, the instructor has the added ability to lock students out of forbidden activities such as surfing the internet, while individually monitoring student desktop notebooks to ascertain where students are making mistakes. This enables an instructor to monitor the usefulness of his or her teaching techniques and to instantaneously make adjustments as needed on a student by student basis. For students with

² DynoVision can be seen at www.dyknow.com

³ Classroom Presenter can be tested at <http://www.cs.washington.edu/education/dl/prenter/>

⁴ Netsupport School can be viewed at <http://www.netsupportschool.com/>

disabilities who may not wish to, or be able to, make on-the-spot inquiries about a particular point of difficulty in their studies, this technology can be invaluable since it can allow them to virtually “show” an instructor their work without having to draw unwanted attention to themselves. The same technology used by an instructor can allow the teacher to be proactive rather than reactive in dealing with student problems while monitoring regular classroom work using the X60-636346U tablet as a teaching and monitoring tool.

The X60-636346U follows many of the principles of Universal Design for Learning as listed in King’s (1999) article, in that it is:

- **Equitable:** It can be marketed successfully to any group because its features can be used or manipulated to meet the needs of a diverse group of users, including those whose needs can only be met by the use of symbols or push-button technology.
- **Flexible:** Its features, such as the touch screen, can be used or modified according to the needs or preferences of a wide range of users with varying needs and capabilities.
- **Simple and Intuitive:** The X60-636346U, with One-Note software, can be used by the very young and the inexperienced with very little training. A simple point and touch of the stylus or a fingertip will open programs and files, move the cursor, and do a full range of other functions. The icons are also clear and intuitive, thus making this tablet easier to learn for students with cognitive disabilities or those who need symbols.
- **Tolerance for Error:** The rugged build of the X60-636346U tablet, and the fact that it is built to sustain drops and jolts, make this tablet useable for a person with a disability who may not always be able to hold on to it firmly. In addition to this, the simplicity of the One-Note and Tablet edition software soften the impact of errors, while the one-button system recovery is a handy feature should a user inadvertently erase something vital. Its extra-long battery life will also prevent much of the frustration attendant on laptops with shorter battery-life spans and complex cords and charging devices.

- **Low Physical Effort:** The X60-636346U is lightweight, and when used in its tablet form is no bigger than the average paper notebook. It does not take more than the push of a button and a flick of the wrist to transform the notebook into a tablet. Lenovo also carries a tablet sleeve which allows the user to carry the tablet safely with a shoulder strap, while providing access to the screen through a clear plastic window which also acts to protect the screen surface from scratches, moisture, handling, and dirt. In addition to this, by scanning course textbooks into the tablet, or using e-text materials, a student with physical impediments or mobility issues does not need to carry any extra weight since the tablet can store everything. Students with cognitive issues which may make them forgetful or apt to lose track of multiple objects, do not need to carry anything in addition to the X60-636346U since the tablet will act as a storage device, reading device, videotaping device and more, thus minimizing the chances of misplacing or losing vital notes or texts.

The Pros and Cons of the Lenovo X-60

The most significant obstacles that the Lenovo X60-636346U models present to a potential user are twofold: cost and training. At approximately \$2,900 Canadian, before taxes, and with all of the options listed in this review included, the X60-636346U is much more costly than a simple notebook PC and, unless it is covered by a disability grant or other AT funding, will probably be beyond the reach of families at the lower end of the socio-economic scale. However, Lenovo does lease its computers, which may be a good short-term solution for a disability department to consider on behalf of a student who is either struggling financially or is just testing the X60 for practicability.

Lenovo provides exemplary customer service should users need help setting up their system or accessing any of its features. Free technical assistance is available through internet detection and scanning of the user's system, or by telephone and e-mail. However, it is presumed that the client has at least basic computer skills, so no training is offered. Microsoft offers tutorials on its website of the software programs such as

One-Note but, again, user familiarity with a basic Office environment is presumed.

As vendors, Lenovo and its resellers do not provide training on any of their models, so training for students with disabilities would have to come from disability professionals who are familiar with the X60 or similar models and the software on them. For most of today's students at the post-secondary and high school level this is not a problem, as a significant number of students are computer literate to an inordinate degree, even at the preschool level in this author's experience. Again, for those from the lower end of the socio-economic scale who do not have access to even a basic computing system in the home, the Lenovo X60-636346U and other models, although intuitive to use, may present a problem initially. The manuals for the X60 tablet PC are in PDF format, and are provided on software CDs which accompany the system.

On the plus side, the X60-636346U is lightweight, portable, fully functional as a laptop and tablet PC, and it can function impressively as a desktop PC when docked and connected to peripheral devices. Its display is fully interactive, and can accommodate even the most unsteady of hands through the use of touch-screen technology and text/image resizing options. In addition, it can be outfitted with a button system for users who have extreme mobility or arthritis related issues. Utilizing Microsoft One-Note software, the X60-636346U makes changing screen colors for easier viewing, or color preferences a snap, and the screen-writer stylus allows the user to erase errors in both written and typed text with its handy eraser end, thus mimicking the familiar feel and functionality of pen and paper. Finally, the Lenovo X60-636346U provides the user who has basic computer knowledge with a powerful tool for learning, sharing work, and enhanced classroom participation and social interaction.

How Does the Lenovo X-60 Support Classroom Participation?

Like other tablet PCs, use of the Lenovo X60-636346U provides instructors with a good alternative to whiteboard or blackboard use, offering flexibility and increased student participation both in-class and

after class (Derting & Cox, 2007). Derting and Cox (2007), professors of biological sciences and chemistry at Murray State University, have been using class-room wide tablet PCs since 2004, and have assessed and surveyed over 800 students using tablet technology. They found that the use of tablet PCs force faculty to evaluate and transform their teaching strategies to adapt to the needs of student users. Instructors using the tablets can detect mistakes or student confusion simply by monitoring all student tablet desktops on their own tablet PC using software such as that mentioned earlier in this review. This allows the instructor to assist and correct any student instantaneously and privately without the need for either students or professors to do more than interact through writing on their screen. This can be done in class, remotely from home, or on fieldtrips.

Derting and Cox (2007) also found that students in large lecture halls are no longer anonymous and distant with tablet PCs. Students are able to engage with both the instructor and each other using the interactive programs available for tablet users, thus increasing the amount of learning, participation, and knowledge sharing and generation, per class, exponentially. For students with disabilities, this could serve to open up an avenue to increased participation and a more active and dynamic social role in classroom activities.

In a study of one-tablet classrooms, Derting and Cox found:

For example, a one-tablet classroom approach has been developed that has a) improved classroom dynamics and interaction with students due to the mobility of the tablet PC and flexibility of a wireless projector, b) allowed instructors to create enhanced lecture notes due to the inking/highlighting tools of the tablet that can be archived for continuous student access, c) promoted the development of peer-led exercises in the classroom where student groups record answers on the tablet to be shared with the rest of the class and archived for later study and d) facilitated the offering of virtual office hours in Blackboard or Elluminate utilizing pen-based technology that allows instructors to easily draw structures, diagrams and

mathematical equations. Multi-tablet and field-based approaches have also been developed that allow students to engage with each other inside and outside the classroom to solve problems and document and study natural phenomena. (2007, no pagination)

The implications for students with disabilities are obvious and compelling in that many students who were previously unable to truly participate as active, equal members in knowledge generation because of their disabilities, now have the potential to work on a level playing field, especially in classrooms where the instructor and other students have access to tablet PCs too. Even without this possibility, the benefits of the X60-636346U to a single user with disabilities can help that person to participate in a more equal and focused manner in classroom and other activities.

Literature Concerning Tablet PCs

Perhaps not surprisingly, a great deal of the literature regarding the use of tablet PCs is produced by educators or computer industry professionals such as Microsoft, who have a stake in promoting and selling these products. Microsoft.com has produced literature regarding the innovative use of tablet PCs by clients such as the Brookfield Zoo in Chicago, which, in 2004, created an innovative program designed to teach primary school children conservation, data collection and the ins and outs of scientific observation techniques using tablet PCs. Students with visual impairments benefited from the high contrast screen options and modifiable font features in which the zoo presented both the data and the presentation lecture on the tablets. Deaf students benefited from being able to read the zoo presentation lecture presented in print and symbol format. Blind students benefited by being able to listen to the zoo presentation lecture, record it, and then replay the necessary parts of it when needed for their data analysis. Other features such as wireless connectivity allowed the students to both download the information they needed to their tablets, and to later upload their data analysis to the zoo server for storage and assessment. Students, including those with attention deficit disorders, benefited from the interesting and interactive

animated characters which were created to guide the students through their studies via a series of tutorials (Microsoft.com, 2004). Even those with very limited mobility were able to use push-button technology to use the features on their tablet PCs, and so were included interactively rather than passively as participating “student scientists” for the very first time (Microsoft.com, 2004).

The success of this venture prompted the zoo to expand its use of tablet PCs for staff and younger classroom visitors because of the increased access to learning and data analysis that the tablets provided for all student visitors. The ability of the tablet PCs to interface effectively with a variety of media impressed all concerned, and the instructors noted that the challenge presented by learning new technologies enthused and excited all of the students collectively (Microsoft.com).

Studies such as the “One-Tablet Classroom” model by Derting and Cox (2007) have demonstrated that tablet PCs enhance both teaching and learning possibilities for all students, and that tablet PCs force faculty to adopt new and innovative teaching strategies which are exciting and knowledge-enhancing for all concerned.

Finally, Appleby College in Oakville, Ontario has used tablet technology for the past eight years and, impressed with the results their students were achieving, purchased 880 tablets for use by students from grades seven to twelve (Sutton, 2006). The digital ink capacity of the Lenovo tablets allows students and faculty to draw, do complex calculations, and reproduce diagrams such as those used in chemistry, physics and mathematics (Sutton, 2006).

Conclusion

To summarize, this reviewer endorses the Lenovo X60-636346U as a tool which encourages student independence, maximizes classroom participation, and produces enhanced knowledge generation in both peer-to-peer and student to faculty situations. For diverse students with a wide array of disabilities, the X60-636346U can offer a multitude of solutions, especially when used with specialized software programs. The

two drawbacks to this technology are the lack of training available, and the cost of the tablet if a student has no access to funding. It is to be hoped that both of these situations will improve as the technology gains acceptance and becomes more widespread. A brief review of the literature has pointed out that an increasing number of schools, from primary grades to post-secondary institutions, are adopting this technology and producing studies to verify the conclusions reached here.

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Author Note

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