VISUALIZATION OF INFORMATION IN A PC TIME MANAGEMENT TOOL FOR UNIVERSITY STUDENTS

As a Case of Communication Design Studies

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Abstract: The present study proposed a PC time management tool for university students and considered the visualization of information from a point of view of communication design. From literature review, student interview and trial use of current PC time management tools we derived 3 design concepts; 1) Using their free time, students can improve their time management ability, 2) students can separate and displayed their plans, and 3) students can easily browse and input the plans. The proposal had 2 innovations about the visualization: displaying free time in a day and setting the timetable of class as core schedule. Five experiments examined the prototypes and revealed modification points. In conclusion, to make students aware of time management, the tool should have following features; 1) the free time in a day is presented in a pie chart, 2) the school plans are separated from the private plans and presented in a different window, and 3) the countdown window announces the important schedules.

Keywords: Visualization of information, Time management tool, University students, Information Gestalt

1. Introduction

The present study confirmed what kind of information should be visualized to improve time management ability of university students. Visualization of information is an important matter for communication design. That is "infographics", the design of information [1]. In the domain of psychology, graphic organizer is similar to the infographics [2].

Most of Japanese students start to manage their time after entering university. They choose classes, part time jobs and other activities, although the school usually prepared for the timetable of classes in their high-school days. They have responsibility for their own time in their college days. A previous study revealed their rather poor ability of time management [3]. Dairy experience of professors may support this view.

The present study proposed an interface design of PC time management tool for university students. Through design work, we examined the effective visualization of information as a communication design study.

2. Survey

We surveyed 1) views of general books about the time management, 2) views of students about the time management, and 3) trial use of the current PC tools for time management, to conduct the present study.

2.1. Functions required in the time management tools

Time management may be a hot popular topic in the general books. Including academic paper [4], these general books gave us suggestions about essential points to manage our time [5, 6, for instance]. We summarized them as 4 points: priority of plans, free time, division of plans, and usability of input and browsing.

For the time management, it is an important action to set up the priority of plans. But the university students may not set up it, if someone does not urge them. As for the free time, they need it to do what they want to do or must to do. In other words, people have to make time to do these things. The students should be conscious of having current free time. The division of plans is a general way for
businessmen to manage their time. Also the students may have some aspects in their life. The usability of tools is, needless to say, important; especially, the browsing is more important than the input, because the browsing means the confirmation of plans.

Thus, we summarized 4 functions required in our proposal; (1) Users can be aware of the priority of plans, (2) users can grasp their free time, (3) users can divide plans into categories, and (4) users can easily input the plans and browse them.

2.2. Student interview about the time management

Sixteen undergraduate students participated in the semi-structured interview. Although the amount of participants was rather small, we conducted an interview to know their real life about the time management.

Eleven students (68.8 %) used the notebook, 3 students (18.8 %) used the mobile phone, 1 student (6.3 %) used the PC tool for the time management, and 1 student (6.3 %) used his own brain. The most frequent reason (6/11, 54.5 %) to use the notebook was its high portability. Thirteen students (81.3%) were not sure which tool they would use in the next year at the end of use of the current tool.

Twelve students (75 %) were creative with the tool, for instance selecting the tool adequate to them or using original color-coding system. In this case, the tool was the notebook. Combination of tools, mobile phone and PC tool or mobile phone and notebook, was also reported as a device for the time management. However, the students who used two tools confessed that it was a pain.

Information that the students wrote or input in the tool was summarized into 2 categories, plans and other matters. Other matters were diary, record of money, and so on. Plans were grouped into 3 categories, general plans, specific ones and limited one. The general plans were which most of all students had as their schedule, like school, after school activity, part-time job, appointment to meet someone, and other private matters. The specific plans were written by not all of students, which were about birthday of their friends or date. The limited plan was the job-hunting that most of all students must do during a limited time period.

School plans were about class, examination, deadline, and so on. We considered those plans as most important for students, because they could not freely change these schedules. If the school plans are not fixed, the students cannot determine all other plans like to see someone or to do a part-time job.

2.3. Trial use of current PC time management tools by students

As mentioned above, users of the PC time management tool was in the minority. But they considered the portability of tool as very important. According to the technology, synchronization performance of the PC with other digital devices tool is developed. Thus, we tested 3 PC time management tools, iCal, Google Calendar, and Yahoo! Calendar by 11 students in total for 1 month to know the usability of these tools. We wanted to know how the students who were not used to the PC tools used them.

Four students used iCal. iCal has a function to separate plans by colors, but only 2 students used this function. All students selected 1-month display style. No one shared the data with others. And 2 of them synchronized iCal with their mobile phone. Moreover, we got two discontent points, “impossibility of constantly displaying the time input” and “impossibility of copy and paste of the plan input”. However, iCal has these two functions as default. Three of them complained about input mode. But 3 of them said they would continue to use iCal.

Four students used Google Calendar. Only 1 student used color separation system. No one shared the data with others. Two students displayed the schedule using 1-month display, and other 2 students used a week schedule. Two of them synchronized Google Calendar with their mobile phone. No one used Google Calendar while offline. Two of them complained about learning how to use. Two of them complained about the pop-up editor inevitably appeared in the day cell after cricking. But all of them said they would continue to use Google Calendar.

Three students used Yahoo! Calendar. No one used the time guard function that can display others calendar or event schedule next to own calendar. One student used the reminder function. Two students displayed the plans as a list, and other student used the 1-month display. Two students synchronized Yahoo! Calendar with their mobile phone. They complained about unavailability of PC use or Internet. Just 1 student said he would continue to use Yahoo! Calendar.

Thus, students found some inconveniences and did not use many functions. However, a majority of students wanted to use the PC time management tool.

3. Design concepts

The proposal was an interface of PC time management tool. We started this study to make students think about their time management ability. Referring to 4 required functions mentioned in 2.1 and current students’ behaviour
about the time management mentioned in 2.2 and 2.3, we set 3 design concepts; 1) Using their free time, students can improve their time management ability, 2) Students can separate and displayed their plans, and 3) Students can easily browse and input the plans.

The proposal has two distinct features as graphical aspect. One is the display of free time (Figure 1a). The free time that means no-scheduled time in each day was displayed. This was not text information, but a pie chart to make directly students aware of their free time in a certain day. We set out more intuitive presentation of information. In the pie chart, gray area meant the time that the participant had some plans. The free time was represented as white area with text like “18.5 h”. Other feature was the separation of school schedule. We set the class schedule as the central matter. As mentioned before, the class schedule was essential and unchangeable for students. In Figure 1b, 5 cells in a dark gray bar represented timetable of class, because all of participants possibly had 5 classes in a day at a maximum. If the participant had a class, the light gray cell changed its color. Class’s name appeared in an index box.

In the next section, we described the verification process and the refining our proposal.

(a) 19.5h (b) 18.5h

Figure 1. Display of free time (a) and timetable bar (b)

4. Verification process

We conducted 5 experiments. According to the results, we refined the proposal. Four freshmen and 1 sophomore participated in the following 5 experiments and took an interview. Experiment 1, 2, and 3 used a static display to check the fundamental graphic in the proposal. In experiment 4 and 5, the students used a PC application. In each experiment, the display was personalized according to each participant. Thus, the participants could see their real schedule in a certain period in each experiment. The participant was asked to put this schedule in the desktop and see it.

4.1. Experiment 1

4.1.1. Features of the first prototype

Figure 2 is the display in the first prototype. This had just a school plan display. Other plans like a part time job were shown as a gray bar that had no text information. The time line was implicitly presented using the school time schedule; for instance, if the gray bar appeared after the final block the participant had a private plan after 17:40.

After 1-week use, the participants were interviewed about visual image, timetable bar, index, pie chart, and priority of plans.

![Figure 2. Display of the first prototype](image)

4.1.2. Results and discussion

As overall visual image, we generally got positive comments: “visible (by 2 participants)”, “good size of letters (by 3 participants)”, and “simple and beautiful layout that I want to put in the desktop”. But we got a negative comment from 1 participant, “too simple and hard to understand what represents at a glance”. Thus, we decided to keep overall image of appearance, but to add needed information.

About the timetable bar, all comments were negative; “It was bothering to see the cell color and to match it to the name in the index box (by 3 participants)”, “It was hard to distinguish the colors (by 2 participants)”, “I did not like this color combination”, “I needed the text information of beginning time”, and so on. In the experiment 1, we set the color at random and we put different color to each class. But the participants complained the usage of color. Thus, after the next prototype, the participants would be able to set the class colors themselves.

About the class name index, we asked if it should always appear. All of participants said yes to this question. They needed the text information of the class name. Thus, we decided to represent the name at any time, but in another style of the first prototype.

We asked the effect of the pie chart of free time. We got 7 positive comments and 2 negative comments. As positive ones, “I thought I was busy, but I realized I had much time to do anything”, “It was good to realize the difference
between the time I thought and the time I really would have”, “It was a fresh way to grasp my time”, “I made up mind to finish the task until that day”, and so on. The negative comments were “I did not feel trying to make effective use of time” and “I confused which part was my free time”. They seemed to enjoy this new way to emphasize their free time. Usually, students may pay attention to the time when they have to do something. But in our proposal, they could realize they had much time of free in which they could do anything they wanted. We led them on to look at “absence”, that is “no plans”. It was a new sensation to the participants. However, one participant said that the pie chart did not push him to use his time effectively. We should add another function on the pie chart. And we must consider the color combination.

About the priority, we asked which information the participants wanted to enlarge, timetable, other plans, or free time. Four of them said that the most important was the timetable. Other participant who was sophomore said that the most important one was the free time. Freshmen have many classes but upper-class students do not. The needs or emphasis would change as they go up. Our proposal should change the size of items according to their needs.

4.2. Experiment 2

4.2.1. Features of the second prototype

Figure 3 and 4 are the displays in the second prototype. There were 3 modification points from the first prototype. The first one was the background color; in the second prototype, it was black to emphasize the part of free time in the pie chart. According to the change of background, we heightened the colors of bar and cells. Secondly, we separated the school plan from the private plan and set 2 windows. In the school plan window (Figure 3), the participants could freely set the color of class. The class name appeared next to the colored cell; this is the third modification and in the second prototype there was no index box. Dark gray cells meant the private plans. Also in the private plan window (Figure 4), the participants could set the color of each plan as they wanted. The text information appeared next to the colored cell. The class was represented in the dark gray cells there. After 1-week use, the participants were interviewed about the color change, meaning of dark gray cells, coloring of classes, position of class names, 2-window system, and text information in the private plan.

4.2.2. Results and discussion

About the color change, all of comments we got were positive; for instance “It was more easily viewable than in the first model” (by 2 participants), “It was cool”, “I like this color” and so on. We changed the background color to emphasize the pie chart. This was effective not only for the visibility of the information but also for user emotion.

About the meaning of gray cells, 4 of 5 participants were for the proposal; “I understood the meaning at a glance (by 3 participants)”, and “It was understandable and easy to distinguish the hour planned and that not-planned”. But 1 participant was against the proposal; “It was pell-mell and almost sickening.” Thus, the dark gray cell representing other plans was understandable but complicated the appearance. We must not emphasize the secondary plans in a certain window.

About the coloring of timetable, 2 participants said “it was necessary”. Two participants recognized it as necessary, if they could change the color by themselves. One participant wanted to group the classes and to distribute colors to them; he did not want to distribute colors to the class, but to the group of classes. Thus, all of them needed the coloring of timetable. But, the users should set the color, because they have own way to use the color.

About the position of class names, all participants confirmed this second prototype. Thus, we decided to
discarded the index box in the first prototype, and put the names next to the colored cells.

About the 2-window system, also about this modification, all participants were positive; “All information of classes and privates would pell-mell the window, if there was a window (by 2 participants)”, “If I checked certain information about the class, I just wanted to see only the class information; the private plans were not needed in this case (by 2 participants)”, and “the 2-window system can have much information”. The need of separation of the school plan from the private one and the amount of information seemed to push the participants into using the 2-window system. They preferred to the separation of information than the information-intensive display used in the first prototype.

About the text information in the private plan, 2 participants wanted to put the place except to the title and its time. But other 2 participants said there was no information that they wanted to add. In the experiment 2, the period of usage was only 1 week, so that the amount of information differed according to participant. After application test mentioned below, we would set other display style except to the week-style and reexamine the amount of text information.

4.3. Experiment 3

4.3.1. Features of the third prototype

In the third prototype, we added a countdown function to improve the time management ability of the participants, because one participant said that the pie chart did not push him to use his time effectively in the experiment 1. Other appearance was the same as in the experiment 2.

The countdown was presented below the pie chart as text information (Figure 5). It was 2-week countdown; if the participant had an examination on 3 December, he or she saw the text “only 14 days until the exam of ...” on 19 November.

We asked the participants about the need of the countdown, their feeling to see it, and the effect to their planning.

4.3.2. Results and discussion

About the need, 2 participants wanted to display the countdown, when they needed. One participant wanted it every time. Another participant wanted a real-time countdown system. The last participant felt it as interesting but did not looked at it many times; he pointed out the problem about the display in the case of increase of information. Thus, this function would be acceptable, but we had to consider the way of display.

About the feeling, all of them realized the urgency; “I felt pressed a bit”, “It was good to make me feel the urgency”, and “It was good for planning”. We regarded the introduction of the countdown function as succeeded, because the participants felt to do something for the plan like examination.

At last, we directly asked the participants the effect of countdown for their planning behavior. We had 4 positive comments; “It helped the planning for the exam”, “I decided to study in the free time”, “I realized the time when I must study and I could reasonably plan other schedule”, and “I would study more”. But we got a negative comment, “this countdown was not so appealing”. Thus, the countdown system would be effective to use the pie chart of free time. Many participants reflected their schedule or behavior. But we had to elaborate the appearance of the countdown.

4.4. Experiment 4

4.4.1. Features of the forth prototype

The forth prototype was a web application operating in a PC; the participants could directly input and edit their schedule. The application was developed using PHP, HTML, CSS, XML and JavaScript. The data was managed by XML. HTML and CSS controlled the displaying in the browser. Dynamic display was controlled mainly by JavaScript and partially by PHP. This application worked all right in the browser, Safari.

Figure 5. School plan window of the third prototype

Figure 6. School plan window in the forth prototype
Figure 6 is an example of the school window. If the participant clicked the tab of “Private” around the upper-light corner, the private window appeared. The schedule was input using 3 buttons around the lower-left corner; “新規イベント入力 (new event)” and “グループ設定 (group setting)” were for the private planning, and “時間割登録 (timetable input)” was for the school planning. But, to input the private schedule, the participant had to input the group setting first. If the participant clicked the button, each window was up (Figure 7, 8 and 9). Not only class schedule but also private plans could be colored as the participant liked and added with short comments. After the input, if the participant clicked a cell, he or she could modify its content.

Overall appearance of the forth prototype was the same as in the third prototype except the countdown window. If the participant input “重要メモ (important memo)” in the timetable and hovered the mouse over the pie chart, text information was popped out on the pie chart (Figure 10). If the participant had many important memos in a certain day, the countdown matters were represented using a scroll display. Besides the countdown window, the class cell with the important memo was always blinking.

Five participants were simply instructed about the browser, buttons, how to modify the schedule, and 2-window display. We restricted the explanation to the minimum necessary; we expected that they could find the functions, because we tested if they could master our proposal during 1 week. We directly accessed their personal page and checked how they used it 2 or 3 times in a day. After 1-week use, we interviewed each participant about the input of timetable, the countdown, the input of private schedule, the pie chart of free time, and the overall usability.

4.4.2. Results and discussion

About the input of timetable, all participants said that it was easy and that the amount of input items was adequate. About the color setting, 2 participants decided the color according to the class images, 2 participants decided it according to the categories of class, and other participant decided it according to the importance of class. And we also got an opinion about the color setting to heavily weight the color balance.

About the countdown, only 2 participants input the important memo and saw the countdown window. They commented that the blinking cells informed their importance. But one of them said that it was annoying, and other said that two cells in line were less visible and that the rapid blinking gave the pressure. These two participants...
were for the display style of countdown. It was good for them, because they sometimes saw the countdown by chance and remembered the plan. But, in the forth prototype, the countdown window appeared at the right side of the relevant pie chart, so that the window hid the pie chart of the next day. To see the countdown of the next day, the participant had to move the mouse. This was to be improved.

About the input of private schedule, 3 participants said that it was easy operation. But other 2 participants did not understand the procedure and could not input the private schedule. In the forth prototype, to input the private plan, firstly the participant had to make groups using the group setting button. We had to modify this system.

About the pie chart, 2 participants used it but other 3 participants did not. These 3 participants complained about the lack of sleeping, eating and bathing hours in the pie chart. Although these hours are essential for our life, they would differ from day to day. We expected for the participants mentally to subtract these hours from the white part in the pie chart.

About the overall usability, we got positive comment on following points: “overall visual image (by 3 participants)”, “the 2-display system (by 2 participants)”, “the pie chart of free time (by 2 participants)”, “easy operation (by 2 participants)”, “self-setting of colors”, and “indication of date”. But we got following negative comments; “I needed a separate button to go back to the calendar from the modification display (by 3 participants)”, “I needed the selection box to input the date or the hour (by 2 participants)”, “It was not portable and hard to use (by 2 participants)”, “I wanted see the next Monday schedule in a display”, “I wanted to know which color I had used in color setting”, and “I wanted to go back to today’s schedule by one click after viewing other days”.

This proposal was a PC application so that it was not portable. Thus, we asked to the participants the availability of synchronization with the mobile phone. They were definitively positive for this function. We considered the portability as a next function to put on the proposal and the fundamental functions as sufficient.

4.5. Experiment 5
4.5.1. Features of the final prototype

The final prototype was also a web application (Figure 11). There were 6 points of modification compared to the forth prototype; order of buttons, adding of “go-back” button, position of countdown window, adding of a-day display, adding of 1-month calendar, change of announce...
style with the important memo, and number selection system.

As mentioned in the experiment 4, in this proposal, to input the private schedule firstly the participant should set the group of events using the “グループ設定” button. But in the forth prototype, their order was reversed and 2 participant did not input the private schedule. Thus, in the final prototype, the “グループ設定” button was put above the “新規イベント登録” button. Moreover, we did not use the term of“入力” but “登録” in accordance with the “時間割登録” button.

In the forth prototype, when the participant input a new event, the button of “新規イベント入力” or the “時間割登録” transformed into “カレンダーに戻る (go back to the calendar)” button. Thus, the same button had two different appearances and functions. In the final prototype, we separated the “カレンダーに戻る” button and put it at the bottom of the list of buttons.

The position of pop-up window of the countdown appeared the left side of the pie chart. This was the opposite side comparing with the forth prototype. In this new style, the participant can move continuously the mouse over the pie charts, and the pop-up windows appeared.

In the forth prototype, the calendar was represented as a week and the detail information of each plan was usually hidden. If the participant moves the mouse over the pie chart, the countdown window popped up. This function was realized also in the final prototype, but 1-day display system was also added. In the 1-day display, not only the important memos usually appeared in the countdown window but also other memos were shown (Figure 12). The changeover buttons between 1-week display and 1-day display were put in upper-left area of the whole display.

We also added 1-month calendar in the left area of the 1-week display for easy transfer. If the participant clicked a day in the 1-month calendar, he or she could directly jump into the week of that day.

In the forth prototype, if the participant input the important memo in a class cell, the cell blinked. The blinking was annoying, according to a participant. Thus, in the final prototype, the cell did not blink but extended.

The number selection system was introduced to the private event input. Two participants required this function in the experiment 4. The numbers for month, day, hour and minute were selectable. But the participants could directly input the number not to use the selection system, too.

The participants had taken part in the experiment 5 for a month. They were instructed only about the adding of 1-day display, that of 1-month calendar, and the number selection system.

4.5.2. Results and Discussion

Results of interview were summarized as follows.

Three of participants noticed the change of button order and the adding of “カレンダーに戻る” button. Other 2 participants did not notice them; one participant did not complain about this kind of button in the forth prototype and other participant did not input a new event during the experiment 5. Four participants preferred to the buttons in the final prototype than those in the forth one. Other one participant was indifferent to those changes.

No one noticed the change of position of countdown window. When we asked which position was favorable, only one participant preferred to the new position. Other 4 participants were indifferent to the position.

All participants tried viewing the 1-day display, but no one used it at all times. The reasons were that the amount of information was not so different as that in the 1-week display and that it was easier to overlook the schedule in the 1-week display.

Three participants highly evaluated the adding of 1-month calendar for transfer. Other 2 participants did not transfer in many times and they did not use the 1-month calendar.

All participants preferred to the extending style to inform the important memo. The reasons were “the blinking cell was hard to distinguish other normal cells at a glance”, “The extending style was appealing but not annoying”, and “It was cute like a flag”.

Four participants highly evaluated the number selection box. Other 1 participant did not notice this function because of no input of a new event, but admitted its usability. Also in the final prototype, the participant could directly input the number, but no one did.

We asked the change during one month to the participants. Four of them reported the positive change,
after they were used to our proposal; “I could easily input the plans and I became to input a new plan as soon as possible (by 2 participants)”, “I understood the way of modification of schedule and could easily input the plans”, and “I was used to the interface and enjoyed it; if I put many plans, the display became colorful!” Just one participant did not report any change in him. The fact that most of participant enjoyed using our proposal was very important for us, because the pleasure to use the time management schedule may lead to the improvement of time management ability.

Thus, we asked them if they became aware of their free time with our proposal. Four participants were said yes and one participant said no. Comparing the experiment 4, we got a highly positive result. One participant input also the hours of eating and sleeping; this customization would be a good sign for the time management. One participant who did not become aware of the free time had already been aware of it before these experiments.

When we asked their time management ability, all participants reported their poor ability. Thus, we asked how our proposal helped/would help it. Two participants pointed out the effective usage of the countdown function. Other participants reported as follows; “The pie chart of free time and the countdown function make me push”, “The more I put the plans, the better I will manage my time better”, and “It was easy to use. If I use it for long time, I will manage my time more easily”.

We asked the overall usability of our proposal though 5 experiments. Four of them expected the usage in the mobile phone. Two of them were positive 2-display system, the school schedule and the private schedule; they said that it was fresh for them. But one participant did not need the pie chart of free time, because he could recognize his free time in the bar of timetable.

5. Conclusion

To improve the time management ability of university students, we proposed a PC time management tool and examined mainly its interface. We have 2 main ideas, the pie chart of free time and the appealing of class schedule. The first idea was highly approved, when it appeared in the first time. But the users seemed to become habituated to it. The second idea changed into the 2-display system of the school schedule and the private schedule. Moreover, we confirmed the importance of action from the tool in this case; it was the countdown system. But this information should be moderate; it was better for the users to see the information by chance. Required features of the tool that we got through 5 experiments were listed in Table 1.

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<td>2 The school plans are separated from the private plans and presented in a different window.</td>
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<td>About higher usability of display style</td>
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<td>Evidence</td>
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<td>2 The countdown window does not have to appear all time.</td>
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<td>About higher usability of operation</td>
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<td>Evidence</td>
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<td>1 The user can go back to the main display from an editing display just by 1 click.</td>
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<td>2 The user can transfer from a day to other day just by 1 click.</td>
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<td>3 The buttons were in a line according to the user’s input procedure.</td>
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<td>5 The users can use the selection box to input the numbers.</td>
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As for the visualization of information, through the present design proposal, we got an important suggestion about the whole. We considered the school schedule as the core plan for university students and separated the school schedule from other private one. Firstly, we underestimated the private schedule that we considered as secondary one. But the presentation of only main schedule was insufficient. Not only main bones but also the number two information should be represented. In this context, the amount of information should be discussed. The experiment 5 revealed that the 1-day display was not needed comparing to the 1-week display. The users did not want fragments of information, but a unitary one. There is a certain amount of information to easily and understandably get. If the users get too little or too much information, they cannot understand the structure. Then, they will not actively use the time management tool. To make core information and to represent unitary information lead us the grasping the whole. Its Importance was also revealed from the graphical
organizer study [7]. The whole is the organized structure, Gestalt. The present study showed that the time management tool for university students should represent the proper amount of organized information for students to easily grasp. We call it as information Gestalt.

Information Gestalt will be an important concept in the communication design. Further studies will confirm this hypothesis.

6. References